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Agriculture
Forest
Service
Southwestern
Region

Forest Pest Management Report

R-3 84-10

PANDORA MOTH SUPPRESSION PROJECT USING ACEPHATE,
JACOB LAKE, ARIZONA, 1983

Kaibab National Forest
Arizona

April 1984

3440

R-3 84-10

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Kaibab National Forest
Arizona

By

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April 1984

USDA Forest Service, Southwestern Region
State and Private Forestry
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CONTENTS

	Page
ABSTRACT	1
INTRODUCTION	1
OBJECTIVE	3
PROJECT DESCRIPTION	3
Treatment Area	3
Insecticide	3
Air Operations	5
Meteorology	5
Organization	5
Safety	5
Inform and Involve	6
Budget Summary	6
SAMPLING DESIGN	6
Sample Plots	6
Larval Sampling	6
Spray Deposit Assessment	6
Folige Protection Assessment	6
RESULTS AND DISCUSSION	7
Larval Population Reduction	7
Spray Deposit Assessment	7
Foliage Protection Assessment	7
SUMMARY AND RECOMMENDATIONS	9
REFERENCES	9
APPENDIXES	10
Appendix 1. Organizational chart for pandora moth suppression project, Jacob Lake, Arizona, 1983	11
Appendix 2. Budget expenditures for pandora moth suppression project, Jacob Lake, Arizona, 1983	12
Appendix 3. Spray deposit recovery rates, pandora moth suppression project, Jacob Lake, Arizona, 1983	13
Appendix 4. Prespray, 6-day, and 13-day postspray larval counts, pondora moth suppression project, Jacob Lake, Arizona, 1983	15
Appendix 5. Defoliation ratings of treated and untreated plots, pandora moth suppression project, Jacob Lake, Arizona, 1983	16
Appendix 6. A fact sheet describing the pandora moth infestation on the Kaibab National Forest, 1983	17

ABSTRACT

In late May 1983, a pandora moth, Coloradia pandora Blake, suppression project was conducted by Forest Pest Management and Kaibab National Forest personnel over 650 acres near Jacob Lake, Arizona. The objective of the project was to reduce pandora moth larval densities to a level that would prevent heavy defoliation of ponderosa pine in areas of heavy visitor use.

Forty-eight sample trees were systematically established throughout the treatment area. Two sample branches were cut from each tree prior to treatment and at 6 and 13 days following treatment. The mean number of larvae per branch was determined for each sampling period and used to indicate effectiveness of treatment expressed as the percentage reduction in larval density between pre- and post-treatment samples. Effectiveness of treatment was also expressed by foliage protection as assessed by aerial detection surveys and visual ratings from the ground of treated and untreated sample trees.

The insecticide was applied during the morning of May 20 with a Marsh Turbo Thrush S2R-T flying at 150 miles per hour and 50 feet over the canopy. The insecticide formulation was Orthene Forest Spray diluted 1:1 with water. Rhodamine B dye and Orthotrol, an antidrift agent, were added to the tank mix. Application rate was 1 gallon spray formulation (0.75 pound active ingredient) per acre.

Results show the mean number of larvae per branch decreased from 3.69 ± 0.51 SE before treatment to 1.22 ± 0.23 SE and 0.63 ± 0.20 SE at 6 and 13 days after treatment, respectively. Foliage protection assessments made from aerial detection surveys showed defoliation was generally less in the treated area than in most untreated areas within the infestation. However, defoliation ratings determined from plots within the treated and adjacent untreated, infested areas showed no significant difference.

INTRODUCTION

A pandora moth, Coloradia pandora Blake, infestation has been in progress on the North Kaibab Ranger District, Kaibab National Forest, since 1978 (figure 1). This infestation resulted in severe defoliation of ponderosa pines over approximately 5,120 acres in 1979 and 19,000 acres in 1981 (Bennett and Ragenovich 1982). An egg mass survey conducted by Forest Pest Management (FPM) personnel in the fall of 1982 indicated that heavy defoliation could be expected in 1983 over as much as 35,000 acres (Bennett and Andrews 1983).

Based on this prediction and issues and concerns identified in the Draft Environmental Impact Statement, Pandora Moth Management Plan, Kaibab National Forest (USDA 1980), an environmental analysis was

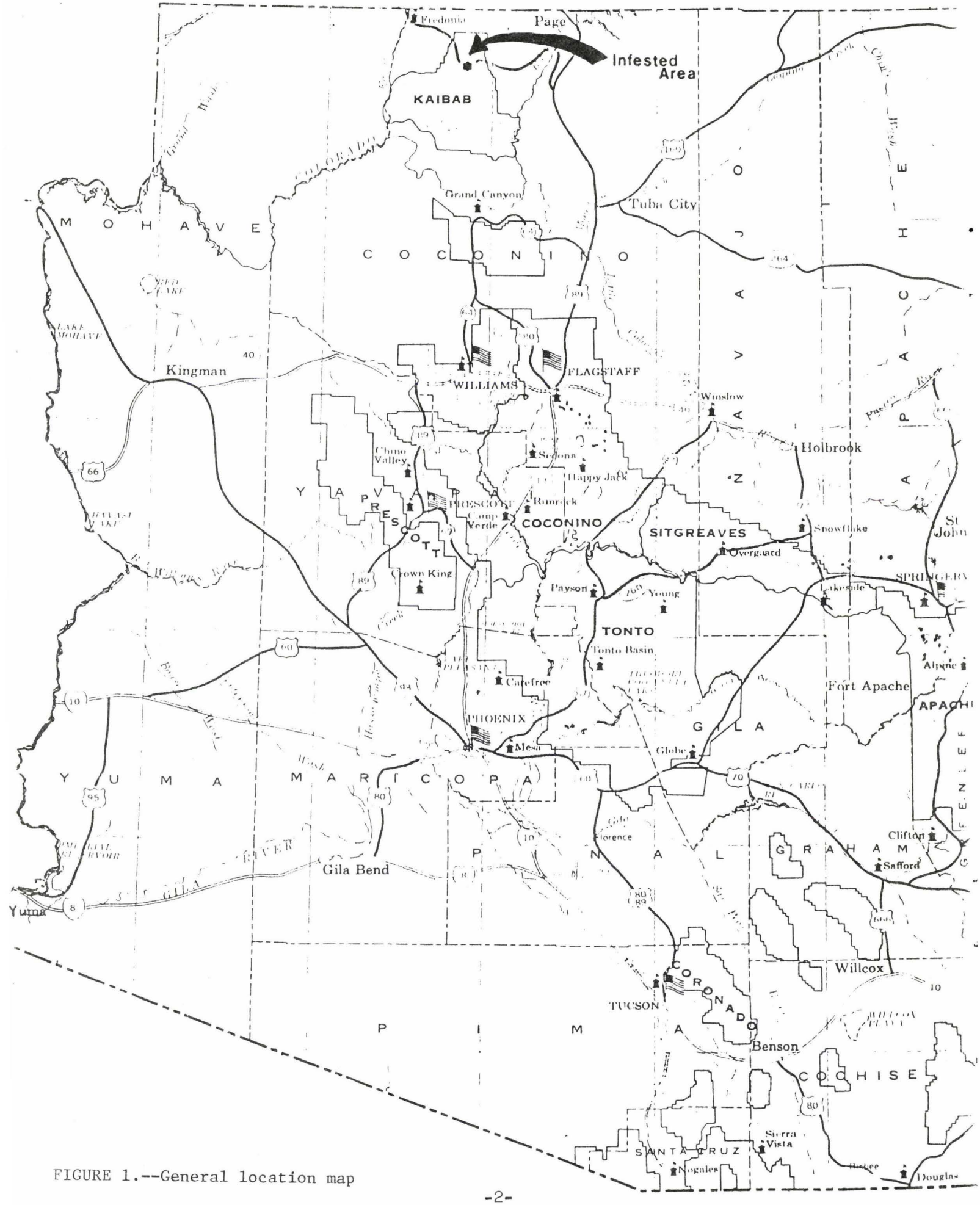

FIGURE 1.--General location map

conducted in 1983. Following that analysis, a decision notice[4] was issued by the Kaibab National Forest Supervisor to proceed with the alternative of treating selected areas in 1983, using the chemical insecticide acephate. This report documents the objectives, methods, and results of that treatment.

OBJECTIVE

The objective of the project was to reduce pandora moth larval densities to a level that would prevent heavy defoliation of ponderosa pine trees in areas of heavy visitor use around Jacob Lake, Arizona.

PROJECT DESCRIPTION

Treatment Area. Treatment area consisted of 650 acres of ponderosa pine forest centered around the high-use recreational area of Jacob Lake, Arizona (figure 2). The topography is gently rolling and dissected by numerous, narrow canyons. Elevations within the treatment area averaged 7,900 feet, with only slight variations. Ponderosa pine is the predominant tree species in the area.

Insecticide. The insecticide selected for this project was acephate[5] (Orthene Forest Spray[6]). It is a broad-spectrum organophosphate which has shown excellent control of several forest defoliators and numerous agricultural insect pests. Field tests conducted against early instar pandora moth larvae in 1980 (Hoffacker, unpublished) and 1982 (Personal communication with John Schmid) and a pilot project conducted against late instar pandora moth larvae in 1981 (Bennett and Ragenovich 1982) all showed acephate effective in reducing larval densities to prevent heavy defoliation. Detailed information on acephate can be found in appendix 1 of the Draft Environmental Statement, Pandora Moth Management Plan, Kaibab National Forest (USDA 1980).

Formulation consisted of Orthene Forest Spray diluted 1:1 with water. Rhodamine B dye and Orthotrol, an antidrift agent, were also added to the formulation at the rates of 1/3 pound and 8 ounces per 100 gallons, respectively.

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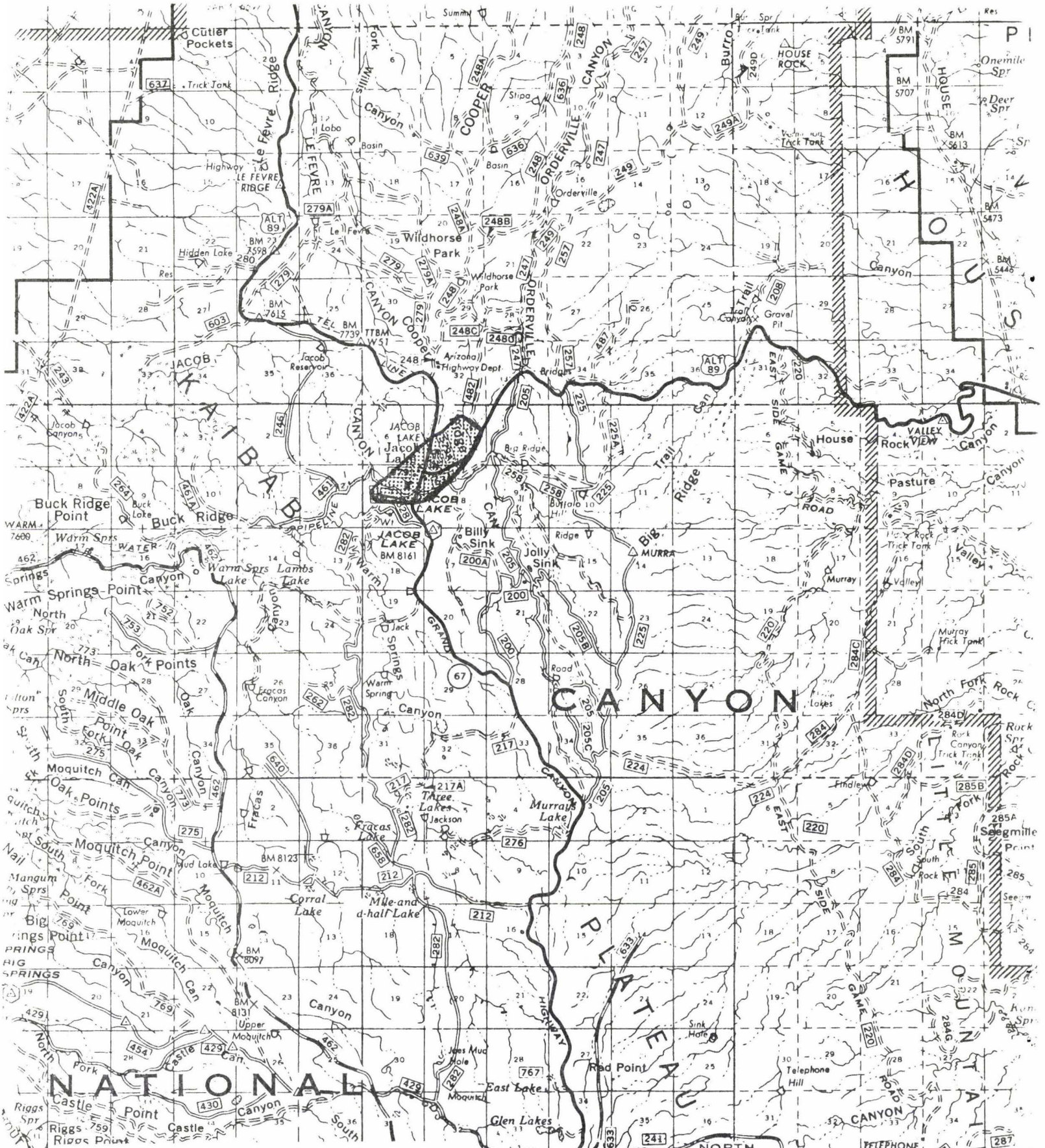
[4]USDA Forest Service. "Pandora Moth Management Plan - 1983 Update North Kaibab Ranger District, Coconino County, Arizona." 1983. 3 pp.
[5]O,S-Dimethyl acetylphosphoramidothioate.
[6]Chevron Chemical Company.


KAIBAB
PLATEAU
NATIONAL
CANYON
HOUSE
ROCK
VALLEY
Cutler Pockets
Le Fevre Ridge
Le Fevre Canyon
Cooper Canyon
Orderville Canyon
Wildhorse Park
Orderville
Jacob Lake
Jacob Reservoir
Jacob Canyon
Buck Ridge Point
Buck Ridge
Buck Lake
Warm Springs Point
Warm Springs Lake
Lambs Lake
North Oak Spr
North Fork Oak Canyon
Middle Oak Point
South Fork Oak Canyon
Moquitch Point
Moquitch Can
Three Lakes
Jackson
Fracas Lake
Corral Lake
Mud Lake
Mile-and-a-half Lake
Lower Moquitch
Upper Moquitch
East Lake
Glen Lakes
Red Point
Sink Hole
Joes Mud Hole
Billy Sink
Jolly Sink
Murray Lake
Big Ridge
Buffalo Hill
Trail Ridge
Rock Valley
Pasture
Murray
Findley
Seegmiller Point
Telephone Hill
Crane Lake
Little Round Valley
Little Pleasant
Tater Point
Kane Ridge
Lost Canyon
Lost Point
Snipe Lake
Castle Point
Riggs Point
Hidden Lake
Wildhorse Park
Arizona Highway Dept.
Trail Canyon
Gravel Pit
Rock Trick Tank
Murray Trick Tank
Rock Canyon Trick Tank
Trick Tank
Deer Spr
Onemile Spr
Warm Spr
Warm Springs
Jack Springs
Fracas Canyon
Warm Spring Canyon
Lost Canyon
Oquer Spr
Sink Hole
Highway
Road
Ridge
Valley
Canyon
Basin
Point
Lake
Spr
Springs
Tank
Gravel Pit
Bridges
Telephone Hill
Kane Ridge
Kane Canyon
Kane Spr
Lost Canyon
Oquer Spr
Snipe Lake
Castle Canyon
Castle Point
Riggs Point
Riggs Spr
Lost Point
Crane Lake
Little Round Valley
Little Pleasant
Tater Point
Telephone Hill
Rock Valley
Valley
Canyon

Air Operations. Application was made on May 20, 1983, between the hours of 5 and 7:30 am. The formulation was applied by a Marsh Turbo Thrush S2R-T. Aircraft operating parameters were:

Aircraft speed	-	150 miles per hour
Swath width	-	150 feet
Boom pressure	-	40 pounds per square inch gage
Release height	-	20 to 50 feet above canopy
Nozzle type	-	Spraying systems 1/8 GGA8W
Number of nozzles	-	29
Nozzle orientation	-	Straight back
Application rate	-	1-gallon formulation (3/4 pound active ingredient) per acre

The spray aircraft was calibrated and characterized prior to treatment to insure the desired application rate. Calibration and characterization, as well as mixing and loading, were conducted at the Kanab Airport, Kanab, Utah, by FPM personnel.

Prior to spraying, the spray aircraft pilot and an aerial observer overflew the treatment area to become familiar with the terrain, reference points, and proposed flight lines. During spray operations, an aerial observer in a chase helicopter was to have maintained surveillance of the spray aircraft and assisted in directing the spray pilot to assure proper application and safety. However, heavy frost covered the helicopter on the morning of treatment, precluding its use. Therefore, smokebombs were ignited at strategic locations within the treatment area to aid the spray pilot in orientation.

Meteorology. Prior to and during the application, local weather forecasts were provided by meteorologists from the National Oceanic and Atmospheric Administration. A weather observer was stationed at Jacob Lake during the application to monitor windspeed, wind direction, relative humidity, precipitation, and temperature.

Organization. The suppression project was a cooperative effort involving the USDA Forest Service, Region 3 (FPM); Kaibab National Forest (KNF) and North Kaibab Ranger District (NKRD); and the Rocky Mountain Forest and Range Experiment Station (RM). Appendix 1 shows an organizational chart for the project.

Safety. Safety was stressed throughout the project. A project safety plan, an aircraft operations for aerial application of chemicals safety plan, a chase helicopter safety plan, and a pesticide safety plan were prepared and included with the project work plan and provided to each person associated with the project. A safety officer was assigned to the project during the application period.

Inform and Involve. An inform and involve plan, developed for the project (Bennett 1983), was followed to insure public involvement and dissemination of information. This included distribution of a fact sheet (shown in appendix 6) describing the pandora moth infestation on the Kaibab National Forest.

Budget Summary. Total cost of this project was $20,170, of which $15,700 was funded by FPM, Washington Office. Cost of application (aircraft and pesticide) was $11.09 per acre. Cost of the total project was $24.15 per acre. Actual expenditures, including salaries, vehicles, and supplies contributed by FPM, are itemized in appendix 2.

SAMPLING DESIGN

Sample Plots. Forty-eight sample plots were established throughout the treatment area along 4 east-west transects spaced 30 chains apart. Each sample plot was separated by about 2 chains and consisted of one open-grown ponderosa pine, 50 to 70 feet tall.

Larval Sampling. Two sample branches, each averaging 20 inches in length, were cut from each sample tree 1 day prior to treatment and at 6 and 13 days following treatment. Sample branches were cut from opposite sides of the tree between 25 and 30 feet above ground. The mean number of larvae per branch for each sampling period was compared to determine the effectiveness of treatment expressed as the percentage reduction in larval density between pre- and post-treatment samples.

Spray Deposit Assessment. Spray deposit cards were assessed by FPM, Washington Office, personnel at Davis, California. The quantitative coverage of the spray near the sample trees and the proper operation of application equipment were assessed using Kromekote cards placed in plastic holders. Two cards were placed parallel to flight lines, under the drip line on opposite sides of each sample tree. Cards were stationed the morning prior to spraying and picked up immediately after treatment.

Foliage Protection Assessment. Foliage protection was assessed during peak defoliation by aerial detection surveys and by visual ratings of treated and untreated sample trees from the ground. Aerial detection surveys were conducted over the entire infestation on July 11 and 12, 1984, by FPM personnel who delineated and rated the defoliation by the following relative classes: Light, moderate, and heavy.

Sample trees in the treated area and trees from adjacent untreated areas were also evaluated for defoliation. The percentage of crown defoliation on each sample tree was classified in one of the following categories:

0 - 0% defoliation

1 - 1-25% defoliation

2 - 26-50% defoliation

3 - 51-75% defoliation

4 - 76-99% defoliation

5 - 100% defoliation

RESULTS AND DISCUSSION

Larval Population Reduction. The mean number of larvae per branch decreased from 3.69 ± 0.51 SE before treatment to 1.22 ± 0.23 SE and 0.63 ± 0.20 SE at 6 and 13 days after treatment, respectively. Larval counts from individual plots for each sample period are shown in appendix 5.

Spray Deposit Assessment. Average drops per cm^2 (7.79), droplet size (304μ), and mass medium (308μ) were within expected ranges. The overall average recovery rate was 0.39 ± 0.05 SE gallons per acre. Recovery rates varied from 0 to 2.84 gallons per acre (appendix 4). The variation was due to overspraying some plots, particularly those in the immediate vicinity of Jacob Lake, while other plots near the boundaries of the spray area were either not sprayed or received only small amounts of spray drift. This variation would probably have been reduced through use of an aerial observer.

Foliage Protection Assessment. Defoliation was generally less in the treatment area than in most untreated areas within the infestation. Aerial detection surveys showed undectable defoliation in the treated area (at the center of the infestation), as well as some areas adjacent to treatment, and light to heavy defoliation throughout 28,525 acres of surrounding host type (figure 3). Of this 28,525 acres of defoliation, 13,250 acres were classified as "light," 11,425 acres as "moderate," and 3,850 acres as "heavy."

Defoliation ratings of the 48 plots within the treated area and 38 plots throughout the adjacent untreated, infested area showed no significant difference: 1.04 ± 0.07 SE for treated plots and 0.98 ± 0.12 SE for untreated plots. These ratings (appendix 5) translate to an average of less than 25 percent defoliation for the sampled trees. This lack of difference (foliage protection) between treated and untreated plots is partially due to the broad, subjective categories

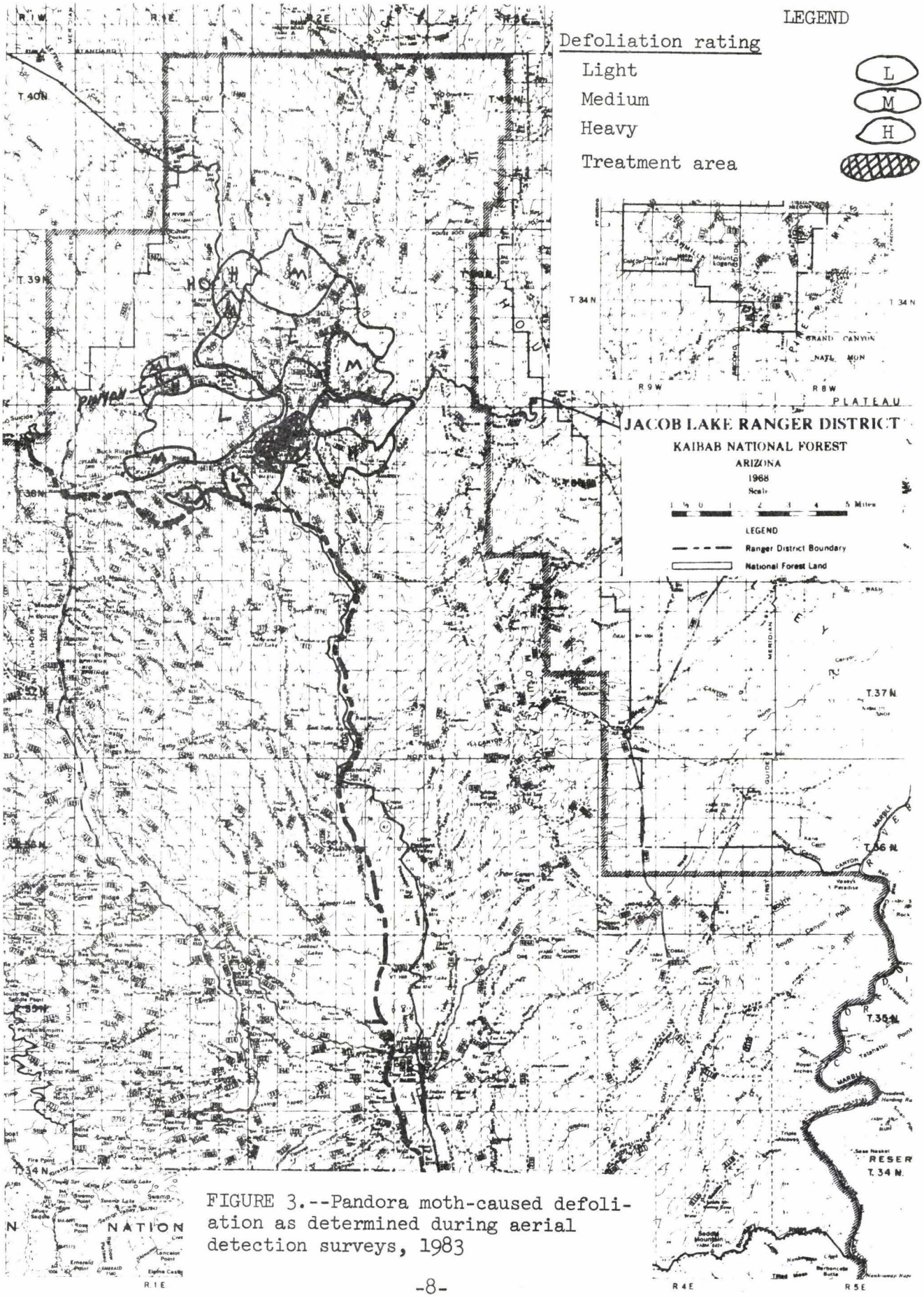


FIGURE 3.--Pandora moth-caused defoliation as determined during aerial detection surveys, 1983

of our rating system. However, the major reason for the light defoliation in the treatment area and throughout much of the infested area, where heavy defoliation had occurred in 1979 and in 1981, was the prevalence of a naturally occurring virus which substantially reduced the larval population in the later larval stages (Bennett and Andrews 1983) and precluded heavy defoliation. Most of the observable defoliation was caused by the early instars before treatment and before viral mortality occurred.

SUMMARY AND RECOMMENDATIONS

In summary, the objective of this project--to reduce pandora moth larval densities to a level that would prevent heavy defoliation of ponderosa pine trees in areas of high visitor use around Jacob Lake, Arizona--was met. Residual larval populations and resultant defoliation were generally less in the treatment area than in nontreated, infested areas.

Since posttreatment surveys of larvae and defoliation throughout the infestation indicate a general decline in the pandora moth population, we recommend an egg mass survey be conducted throughout the Jacob Lake area in the fall of 1984. This survey will enable us to predict the location and extent of defoliation in 1985. If survey results indicate moderate to heavy defoliation is expected in and around the recreational area of Jacob Lake, we would then recommend the Kaibab National Forest conduct another environmental analysis to assess alternatives for management of pandora moth in 1985.

REFERENCES

Bennett, D. D., and M. A. Andrews. 1983. Biological evaluation, pandora moth, Kaibab National Forest, Arizona. USDA Forest Serv. R-3 83-7. 15 pp.

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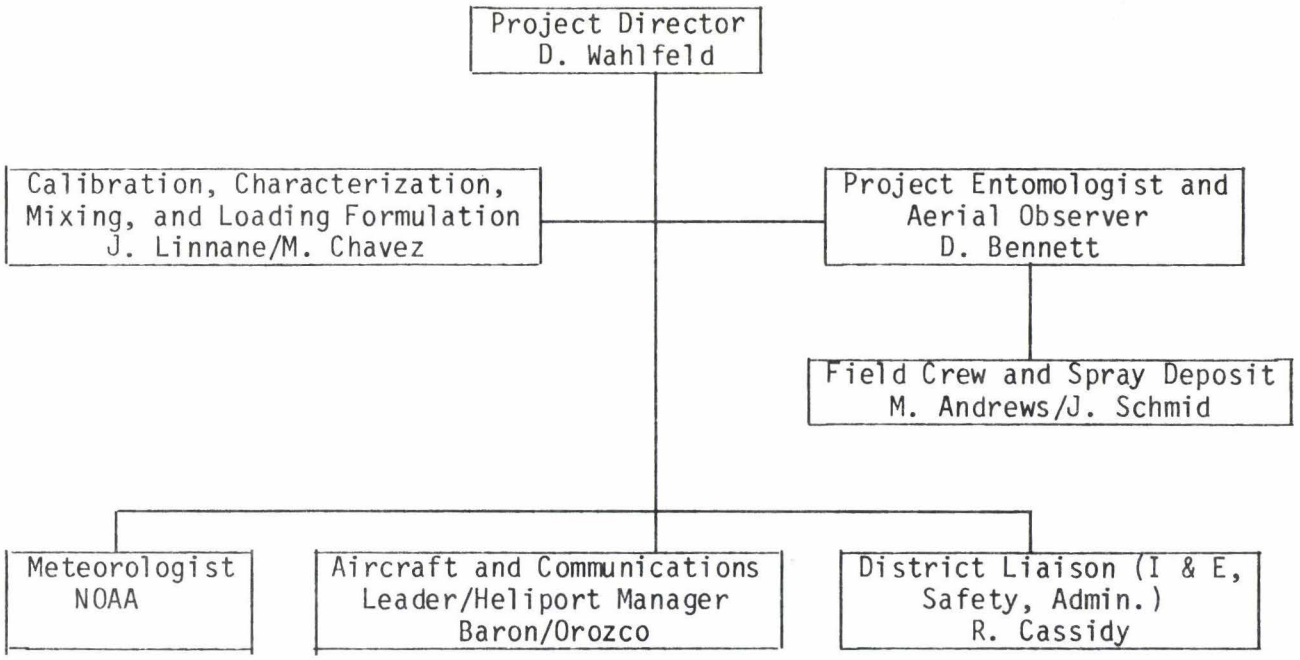
USDA. 1980. Draft environmental impact statement, pandora moth management plan, Kaibab National Forest, Coconino County, Arizona. 60 pp.

APPENDIXES

APPENDIX 1.--Organizational chart for pandora moth suppression project, Jacob Lake, Arizona, 1983



APPENDIX 2.--Budget expenditures for pandora moth suppression project, Jacob Lake, Arizona, 1983

	Project budget	Contributed	Total
Aerial application services	$ 2,980		$ 2,980
Orthene Forest Spray plus shipping	4,228		4,228
Vehicles		$1,100	1,100
Equipment and supplies	1,428		1,428
Personnel			
Administrative assistant		750	750
Formulation crew		920	920
Project entomologist		960	960
Field crew		640	640
Administrative			
Overtime--FPM	939		939
Travel and per diem--FPM	1,725		1,725
Services			
Data analysis		100	100
Kaibab NF--inlcudes helicopter services, salaries, overtime, travel, per diem, and vehicles for: project director, meteorologist, aircraft communications leader, heliport manager, airport manager, and District liaison	2,400		2,400
Overhead	2,000		2,000
TOTAL	$15,700	$4,470	$20,170

APPENDIX 3.--Spray deposit recovery rates, pandora moth suppression project, Jacob Lake, Arizona, 1983

Plot number	Card	Recovery rate Gal/acre	Plot number	Card	Recovery rate Gal/acre
1	A	0.00	16	A	.00
	B	.00		B	.09
2	A	.06	17	A	.27
	B	.15		B	.25
3	A	.18	18	A	0.04
	B	.23		B	.04
4	A	.26	19	A	.62
	B	.32		B	.88
5	A	.63	20	A	.27
	B	.98		B	.31
6	A	2.84	21	A	1.61
	B	1.41		B	1.09
7	A	.00	22	A	.46
	B	.00		B	.36
8	A	.55	23	A	.62
	B	.42		B	.47
9	A	.16	24	A	.32
	B	.17		B	.92
10	A	.47	25	A	.09
	B	1.17		B	.06
11	A	.22	26	A	.03
	B	.00		B	.03
12	A	*	27	A	.03
	B	*		B	.02
13	A	.09	28	A	.02
	B	.12		B	.01
14	A	.35	29	A	.02
	B	.22		B	.01
15	A	.13	30	A	.07
	B	.00		B	.10

* No data collected.

APPENDIX 3.--Spray deposit recovery rates, pandora moth suppression project, Jacob Lake, Arizona, 1983--Continued

Plot number	Card	Recovery rate Gal/acre	Plot number	Card	Recovery rate Gal/acre
31	A	.13	40	A	.05
	B	.08		B	.04
32	A	.21	41	A	.52
	B	.27		B	.30
33	A	.14	42	A	.70
	B	.08		B	.23
34	A	1.05	43	A	.29
	B	.85		B	.34
35	A	.34	44	A	.45
	B	.56		B	.52
36	A	.50	45	A	1.22
	B	.56		B	.64
37	A	.28	46	A	.65
	B	.72		B	.53
38	A	1.11	47	A	.07
	B	1.79		B	.37
39	A	.18	48	A	.11
	B	.61		B	.12

APPENDIX 4.--Prespray, 6-day, and 13-day postspray larval counts, pandora moth suppression project, Jacob Lake, Arizona, 1983

	Average number larvae per branch				Average number larvae per branch		
Plot No.	Prespray	6-day postspray	13-day postspray	Plot No.	Prespray	6-day postspray	13-day postspray
1	5.0	4.0	1.0	25	11.5	4.0	7.0
2	4.0	1.5	.5	26	7.0	1.5	3.5
3	.5	.5	0	27	2.0	1.0	0
4	2.5	1.0	0	28	2.0	1.0	0
5	1.0	.5	.5	29	0	1.5	2
6	1.5	0	0	30	1.5	5.0	1.5
7	1.0	0	0	31	15.0	7.0	5.5
8	5.0	.5	0	32	9.5	.5	0
9	6.5	3.0	2.0	33	0	1.0	0
10	3.0	0	0	34	6.5	0	0
11	0	0	0	35	3.5	.5	0
12	0	0	0	36	2.5	.5	0
13	.5	0	0	37	3.0	.5	0
14	0	1.0	0	38	5.0	.5	0
15	2.0	0	0	39	3.0	.5	0
16	.5	3.5	1.5	40	2.5	4.0	0
17	1.5	0	1.0	41	5.0	1.0	0
18	1.5	3.0	2.5	42	4.5	0	0
19	4.0	.5	.5	43	3.0	.5	0
20	3.0	2.5	0	44	.5	.5	0
21	6.5	0	0	45	1.5	.5	0
22	6.0	0	0	46	1.5	0	0
23	3.5	1.5	0	47	14.0	1.0	.5
24	10.5	0	0	48	3.0	3.0	.5

APPENDIX 5.--Defoliation ratings of treated and untreated plots, pandora moth suppression project, Jacob Lake, Arizona, 1983

Treated plots	
Plot number	Defoliation rating
1	2
2	2
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	1
12	1
13	0
14	1
15	0
16	1
17	1
18	1
19	1
20	1
21	1
22	1
23	0
24	1
25	3
26	1
27	1
28	1
29	2
30	1
31	2
32	1
33	1
34	1
35	1
36	0
37	1
38	1
39	1
40	1
41	1
42	1
43	1
44	1
45	1
46	1
48	1
$\bar{x}$	1 .04 ± .07 SE

Untreated plots	
Plot number	Defoliation rating
1	1.4[1]
2	1.2
3	1.4
4	1.2
5	.2
6	1.2
7	1.0
8	1.8
9	.8
10	1.0
11	1.0
12	1.0
13	.2
14	2.4
15	2.2
16	1.0
17	2.0
18	1.2
19	1.2
20	2.8
21	0
22	1.0
23	0
24	0
25	0
26	0
27	.8
28	1.4
29	1.6
30	1.4
31	1.0
32	1.0
33	1.0
34	1.0
35	1.0
39	0
40	0
41	0
$\bar{x}$	.98 ± .12 SE

[1]Fractional ratings of the untreated plots are the result of averaging the defoliation rating of five trees per sample plot. The defoliation ratings from the treated plots are based on one tree per plot.

APPENDIX 6.--A fact sheet describing the pandora moth infestation on the Kaibab National Forest, 1983

Fact Sheet

Forest Pest Management

Southwestern Region

March 1983

United States Department of Agriculture

Forest Service

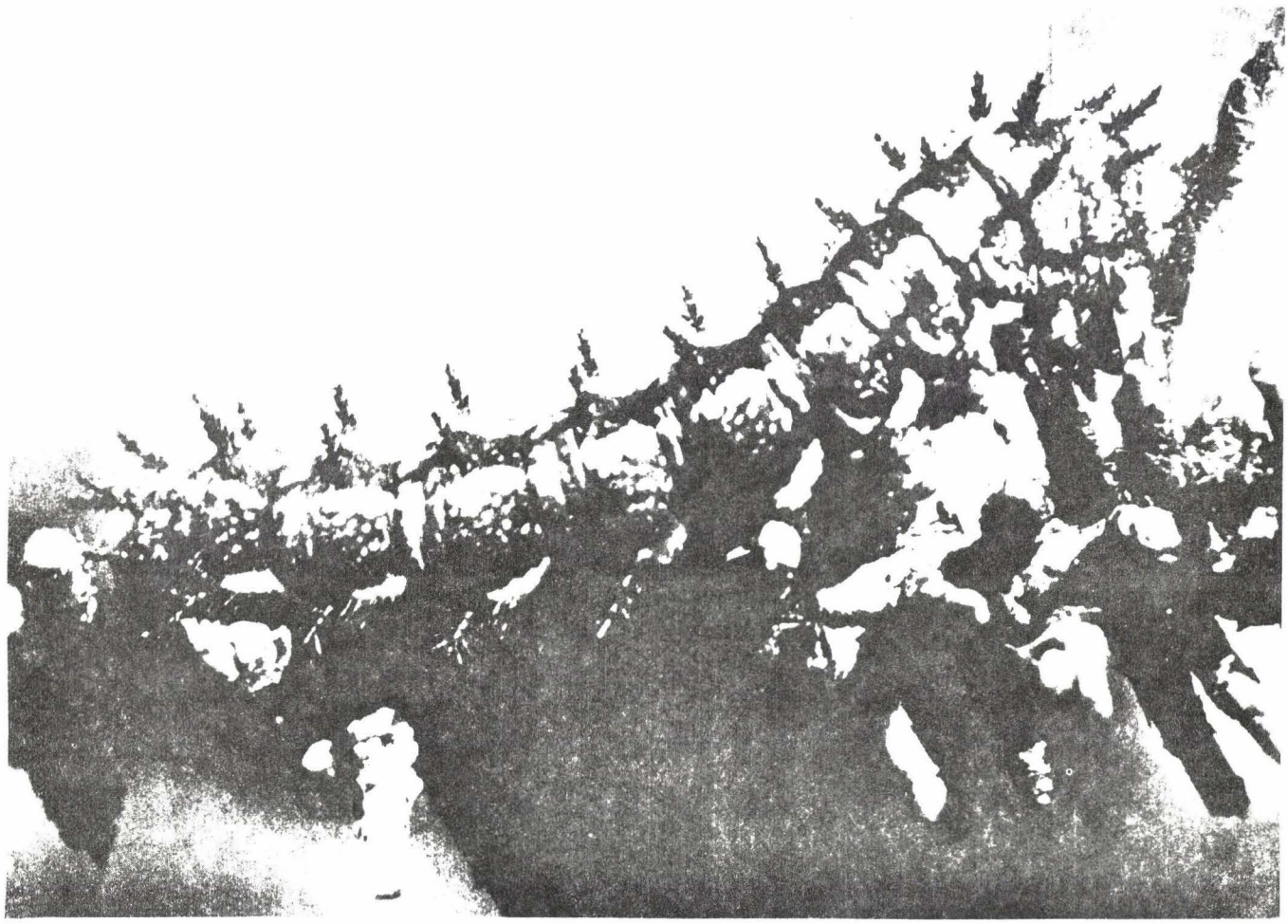
Pandora Moth Kaibab National Forest

The pandora moth, *Coloradia pandora* Blake, is a native insect in ponderosa pine forests in northern Arizona that normally occurs in such low numbers that its presence usually goes unnoticed. However, in 1979, an outbreak occurred near Jacob Lake that resulted in the complete defoliation of 5,000 acres of trees, and moderate to light defoliation on thousands of adjacent acres. By 1981, the outbreak had spread to include over 19,000 acres of heavy defoliation. Survey information indicated the infestation will continue to increase in 1983 and threaten recreation and visual values. As a result, a suppression project was planned to reduce the high density of caterpillars and resultant defoliation of pines in and around the high-use recreational area of Jacob Lake.

The Insect

The pandora moth has a 2-year life cycle (see Fig. 1). Defoliation of trees occurs every other year when the caterpillars are present. When feeding is heavy, stands have a reddish cast and appear to have been damaged by fire. Later, trees get some needle growth on the tips of branches.

Full-grown caterpillars are easy to detect because of their large size (3 inches long), and they can be seen crawling down tree trunks and wandering on the ground. The large showy moths can also be a nuisance when large numbers are attracted to lights.



APPENDIX 6.--A fact sheet describing the pandora moth infestation on the Kaibab National Forest, 1983--Continued

The Project

Based on an environmental assessment with reference to the 1981 draft and final environmental impact statements, a decision was made to conduct a suppression project using the insecticide acephate (Orthene Forest Spray) to manage this insect in a limited area of high recreational use. This material will be aerially applied at a rate of three-fourths pound of active ingredient per acre in the early morning hours during the first week of May. Treatment area will include approximately 600 contiguous acres in the immediate vicinity of Jacob Lake.

The Insecticide

Acephate is an organophosphate insecticide registered for the control of a wide variety of forest and other insect pests. It is sold for home and garden use under the trade name Orthene. It is safe to man at the proposed application rate, although the spray should be avoided, as it may cause mild eye and skin irritation. Medical studies have shown no adverse effects to humans in a plant where acephate was being manufactured, or in agricultural fields where it was applied at higher rates than will be used on this project. The material will not affect automobile paints.

For further information contact one of the following:

Forest Service Visitor Information Center
Jacob Lake, Arizona

OR

USDA Forest Service
Kaibab National Forest
North Kaibab Ranger District
Fredonia, Arizona 86022
(602) 643-5895

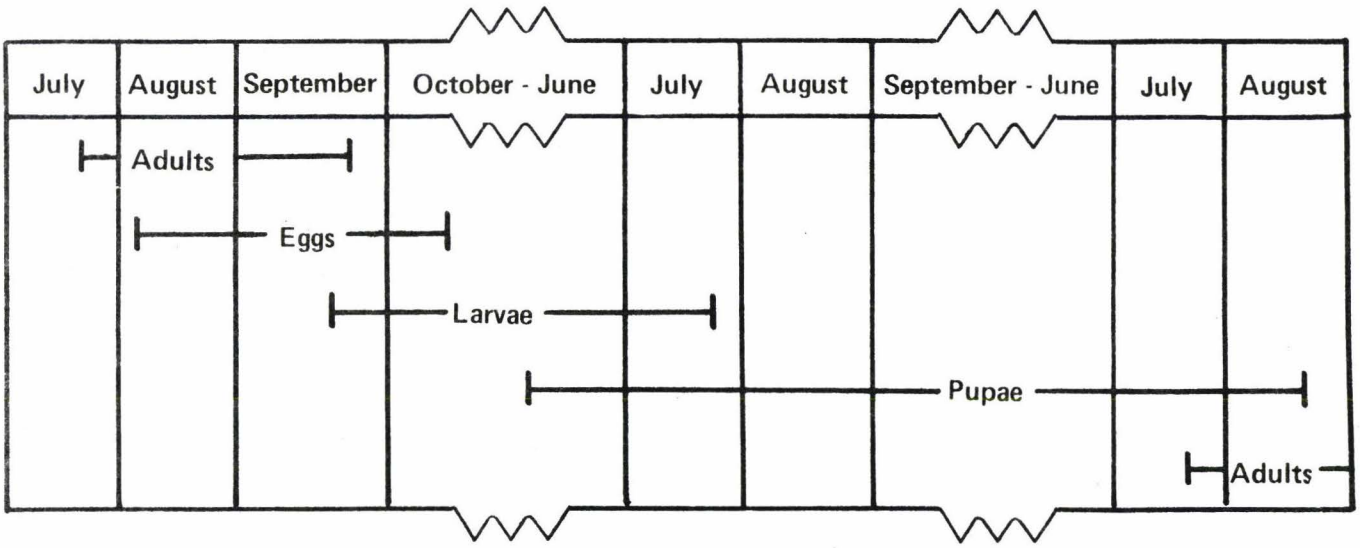


Figure 1. Chart showing pandora moth life stages during its 2-year life cycle based on information collected on the North Kaibab Ranger District, Kaibab National Forest, 1979 through 1982. Time periods for each life stage are averages. A very small percentage of the population might be found earlier or later than the indicated period.

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Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key--out of the reach of children and animals--and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honeybees or other pollinators are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

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